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hope, that the attention of antiquaries may be drawn to the subject, which promises to be of general interest, as I understand that shoes composed of brass or bronze, more or less like those, have been found in other parts of Ireland."

DECEMBER 9, 1850.

HUMPHREY LLOYD, D. D., PRESIDENT,
in the Chair.

THE President communicated the following account of the Cyclone of the 19th of November.

"The leading phenomena of revolving storms at a given place are,—1. the veering of the wind through an angle ranging from 0° to 180° , its magnitude depending on the proximity of the centre of the cyclone; 2. the gradual increase and subsequent decrease of its force; 3. the fall and rise of the barometer. All these characters were distinctly exhibited at Dublin on the 18th and 19th of last month. The gale commenced about 12 P. M. of the 18th, and gradually increased in force until 1 or 2 P. M. of the following day, after which it diminished again. Before it commenced, in the afternoon of the 18th, the direction of the wind was singularly variable, shifting rapidly between S. and E. During the greater part of the forenoon of the 19th, it blew from the S.; at noon from S.W.; at 6 P. M. from W.; and between 1 and 2 A. M. of the following day its direction shifted *suddenly* to N.N.W., and it continued between N. and W. the whole of the day. The barometer underwent a corresponding series of changes, the mercury falling rapidly until near noon, and then rising again. The least observed height was 28.290 inches, at 10 A. M.

"I soon after received from Dr. Robinson and Mr. Cooper detailed accounts of the gale, as observed at Armagh and Markree, from which its rotatory character was still more evi-

dent; but I deferred laying them before the Academy, until I could combine with them the observations made in other parts of Ireland according to the system recently organized. The following are the observations of the direction of the wind, and of the height of the barometer (reduced to 32° Fahr.),* at all the stations from which the results have been as yet forwarded to the Academy. The hours of observation are 9 A. M. and 9 P. M.

STATION.	Lat.	Long.	HEIGHT OF BAROMETER.				DIRECTION OF WIND.			
			18, P. M.	19, A. M.	19, P. M.	20, A. M.	18, P. M.	19, A. M.	19, P. M.	20, A. M.
Portrush. . .	55° 13'	6° 41'	29·100	28·339	28·518	29·044	S.E.	S.E.	N.E.	N.E.
Buncrana. . .	55 8	7 27	29·094	28·300	28·500	29·061	S.S.E.	S.	N.E.	N.N.E.
Killybegs. . .	54 38	8 27	28·928	28·242	28·650	29·150	S.E.	N.	N.	N.
Donaghadee. .	54 38	5 33	29·131	28·376	28·346	28·937	S.E.	S.	N.E.	N.E.
Armagh. . .	54 21	6 39	28·782	27·975	28·298	28·823	S.E.	S.S.E.	N.W.	N.N.W.
Markree. . .	54 12	8 26	28·656	28·126	28·536	29·088	S.E.	N.N.W.	N.W.	N.W.
Dublin. . .	53 21	6 15	29·105	28·362	28·528	28·982	S.S.E.	S.	W.	N.N.W.
Courtown. . .	52 39	6 13	29·192	28·566	28·562	28·924	S.S.W.	S.S.W.	W.S.W.	N.N.W.
Kilrush. . .	52 38	9 30	28·830	28·455	28·706	29·267	S.E.	W.N.W.	W.N.W.	N.W.
Dunmore. . .	52 8	6 59	29·070	28·593	28·633	28·993	S.W.	W.	W.N.W.	N.W.
Caherciveen. .	51 56	10 13	28·855	28·756	29·080	29·370	S.W.	W.N.W.	W.N.W.	N.
Castletownsend.	51 33	9 9	29·115	28·831	28·940	29·207	S.W.	N.W.	W.	N.

“It will be seen from these observations that, at 9 A. M. of the 19th, the wind was blowing from N. at Killybegs, and from S. at Donaghadee; that it was blowing from S.E. at Portrush, and from N.W. at Castletownsend; from S.S.E. at Armagh, and from N.N.W. at Markree. The centre of the vortex was therefore over Ireland at that time, and between the stations mentioned.

“But the most satisfactory mode of discussing these observations is to lay down, on a map, lines in the direction of the wind at the same moment of time at the several stations. It is thus evident that these directions are, very nearly, tangents to concentric circles, the common centre of the circles

* “The reduction to the sea-level has not been applied. The heights of the cisterns above the sea are small at all the coast stations. At Armagh this height is 211·0 feet; at Markree 131·5 feet.”

being of course different at the different epochs. We thus find that the centre of the vortex had a progressive motion from W. S. W. to E. N. E. ; and that it reached the western shores of Ireland about 3 A. M. of the 19th, and quitted the north-eastern about 3 P. M. of the same day. The position of these circles at 9 A. M. of the 19th, together with the direction of the wind at the several stations, is shown in the annexed

diagram. The centre of the vortex was then over the north of the island, in lat. $54^{\circ} 20'$, long. $7^{\circ} 30'$, very nearly.

“It will be seen that the direction of the wind is well represented at all the stations, excepting Buncrana; and the anomaly at this station is readily accounted for by the modifying influence of Lough Swilly, and its double chain of mountains.

“We have seen that the centre of the vortex was between Armagh and Markree at 9 A. M. of the 19th; and, as the direction of its progressive movement was not far from the line connecting these places, it must have passed nearly centrally over both. Hence we should expect there the peculiar phenomena—the *lull* of the wind, and the *sudden reversal* of its direction—which are observed to occur at places in the path of the centre of a cyclone. I shall therefore briefly describe the series of changes at these two stations, which have been kindly furnished in much detail by Dr. Robinson and Mr. Cooper. The observations at Armagh are from the records of the self-registering anemometer, and are consequently *continuous*; those at Markree were taken at short intervals.

“At Armagh the wind began to blow at 7 P. M. of the 18th, with a velocity of 22 miles an hour. The maximum velocity (with the exception of that of a short squall* at 5 A. M.) occurred at 7 A. M. of the 19th, and amounted to 30 miles an hour. From this time the wind abated rapidly *almost to a calm*, its velocity at noon amounting only to 4 miles an hour; and at 3 P. M. it rose again, with a velocity of 15 miles. The initial direction of the gale was from the E. S. E. From 9 P. M. on the 18th, to 1 A. M. on the 19th, it veered to S., at which point it continued for several hours, including the period of greatest force of the gale. At 11 A. M. its direction had returned to S. E., and it then *suddenly shifted to W. N. W.*, altering through 160° in 24 minutes. The *minimum pressure* took place at 11^h 30^m, at the close of this movement; its amount was 27·930 inches.

* During this squall, which lasted only three minutes, the velocity reached 60 miles an hour.

“ At Markree the gale commenced at 4^h 30^m P. M. of the 18th, with a rapidly falling barometer. At 7 P. M. the wind abated to a breeze, the barometer still falling. It recommenced at 10 P. M. from the S. E.; and at 3 A. M. on the 19th it appears to have attained its *maximum*. At 6 A. M. the wind again abated; and at 7 A. M. *there was a calm*. The *minimum pressure* took place at this time, and amounted to 28·058 inches. At 9 A. M. the wind rose again from the N. N. W., but not with such force as before; and in the afternoon there was a strong gale again.

“ From these facts it is evident that the centre of the vortex passed nearly over Markree at 7 A. M., and over Armagh at 11^h 30^m A. M. At Donaghadee, which is nearly in the prolongation of the line connecting the two former places, the wind ceased at 1 P. M., and recommenced at 5 P. M.; so that the vortex passed nearly centrally over this station at about 3 P. M. From these data we learn that the cyclone moved from W. S. W. to E. N. E.; and that the velocity of the progressive movement was about 14 miles an hour.*

“ The dimensions of the vortex may likewise be collected from the same data. The interval between the commencement of the storm, and the passage of the centre, at Armagh, was 16½ hours; and, the velocity being 14 miles an hour, the distance between the front of the vortex and the centre was 230 miles. We have grounds for believing that the posterior portion of the vortex was more considerable, and, conse-

* “ The *direction* of the progressive movement may also be inferred, although not so satisfactorily, from the initial and final directions of the wind, in veering, at any one station. And, the time of the nearest approach of the centre of the vortex being that of least pressure, the *rate* of the progressive movement may be ascertained by a comparison of the heights of the barometer at two distant stations, the direction being known. Thus, the time of the minimum pressure at Caherciveen (deduced by interpolation) was about 3 A. M., and that at Donaghadee about 3 P. M.; which gives a velocity of 18 miles an hour.”

quently, that it deviated from a circular form ; but the gradually diminished force of the gale in the latter portion renders it impossible to fix its close with precision. The total diameter, in the direction of the progressive movement, probably exceeded 500 miles. The magnitude of the (nearly) quiescent portion of air in the centre of the vortex is better defined. At Armagh the lull lasted from three to four hours ; at Markree three hours ; and at Donaghadee four hours. The diameter of the quiescent central portion was therefore about 50 miles.

“ I shall now refer to some particulars connected with this gale, which appear to merit attention—although probably, in the present state of knowledge on this subject, we should not be justified in offering any suggestions in explanation.

“ Among the first of these are the abnormal irregularities in the rotatory movement, especially along the track of the centre. Thus we have seen that, at Markree, there was a subsidence of the gale from 7 P. M. to 10 P. M. of the 18th. There was, in like manner, a *temporary lull* at Armagh, between 3 and 4 A. M. of the 19th. But the most curious irregularity is that of the direction. At Armagh this began to change rapidly at 9 P. M. of the 18th. At 9 P. M. it was E. S. E. ; at 10 P. M., S. E. ; at midnight, S. S. E. ; and at 1 A. M. on the 19th, S. At this point it remained for several hours ; and the *direction then retrograded* through an arc of about 45°. At 9 A. M. on the 19th, it was S. S. E. ; and at 11 A. M. it came back to S. E., after which the *sudden* shift to W. N. W. already noticed, took place.

“ The next point which seems to merit notice is the fact, that the force of the gale was considerably greater to the *south* of the line of passage of its centre, than on that line itself, or to the north of it. Thus, at Killiney, where I made frequent observations during the gale, I found the maximum velocity to be 55 miles an hour ; at Armagh it was but 30 miles. It would be easy to account for this, if we could suppose that

the whole revolving mass of air was transferred *bodily*, in virtue of the progressive movement. But this assumption seems to be negatived by other facts.

“ It has been already mentioned that the greatest force of the storm occurred at Armagh and Markree, *before* the epoch of minimum pressure, the interval at both places being about four hours and a half. A similar interval took place at Killiney, but in the *opposite* direction, the epoch of greatest intensity *following* that of least pressure by four hours and a half.

“ The last point which appears to demand notice is the curious fact, that there was a considerable interval between the epochs of the greatest intensity of the storm at Dublin and at Killiney, places only ten miles apart. The greatest force of the gale, at Dublin, took place between 1 and 2 P. M. ; at Killiney it occurred between 5 and 6 P. M. There is a similar interval between the times of *minimum pressure* at the two places, the least height of the barometer occurring at Killiney at 1 P. M.,—or later than at Dublin by two or three hours. These differences are probably connected with the difference of altitude of the places of observation.

“ I have thought it right to bring this subject under the notice of the Academy, not only on account of the general interest which attaches to it, but also as a specimen of the results which may be expected from the observations recently instituted by this Society. And I gladly avail myself of this opportunity to testify to the fidelity and accuracy with which the observations are now made by the men belonging to the Coast-guard service. So far as regards the meteorological part of the undertaking, little more seems wanting than that, on occasions such as that which forms the subject of this paper, the observations should be taken at shorter intervals.”*

* “ Extra observations were taken during the gale at the Coast-guard stations at Caherciveen and Kilrush.”